We are the makers - IoT Learning Scenario
Bridge Building

1. Title of the Scenario	**Bridge Building**
2. Target group	12-18 years (The learning activity can be very basic, butadvanced topics like finite analysis can be included, therefore the age range is quite wide)
3. Duration	5-6 hours
4. Learning needs	Improvement through iteration, Basic CAD modelling skills, basic 3D printing skills.
5. Expected learning outcomes	Intermediate 3D design Testing of developed solution Improving design through iteration loops Lessons about strength of materials and geometry Learning about real life through a model Having an understanding of the cost benefit relationship of solutions Calculating the volume of cylinders
6. Methodologies	In this learning scenario the students will be modeling and printing bridges, that will be tested on two parameters: Strength and price, and improver over several iterations. This learning scenario allows students to discover powerful and complicated ideas through playful and self driven learning towards the subject matter. As a teacher your role will be to provide questions to make the students reflect on their process, as well as getting them in a mindset of continuous improvement. Inquiry based learning Constructionism Constructivism Project based learning Collaborative learning
7. Place / Environment	Classroom with 3D printers, Makerspace, Fablab or similar.
8. Tools / Materials / Resources	Projector, 3D printers and equipment (spatulars, plyers, tweezers, bed adhesive etc.), computer for each student with internet connection, Slicing software, printed handouts, printed tinkcercad Cheatsheet, weights for testing of the bridge (at least 100kg), painters tape, marker, post its.

9. Step by step description of the activity / content	1. Divide your class into groups of 3-5 people and, if possible, assign one 3D printer per group.
	2. Give the students the design prompt, make sure to let them know that they are expected to produce several bridges, so they will not think they are finished after the first one. Also make sure to let them know that the bridge will be assessed on both material cost and strength.
	3. When the first bridge is being printed, demonstrate for the class how to calculate the price of the bridge, based on the length of the filament used for the print.
	4. When the first print is done demonstrate how to test the strength
	    a. Place the bridge on the ground
	    b. Place a package of paper on top of the bridge
	    c. Gradually place more and more paper packages on top of the bridge.
	    d. Repeat until the bridge breaks
	    e. When the bridge breaks, note down how much weight was needed to break the bridge. This will be the measure of the strength in this test.
	5. When both the strength and price is known, help your students plot the bridge in the Oresmian Coordinate system.
	6. When the bridge is placed correctly, you can encourage your students to reflect on the outcome with questions such as:
	    a. Where did the bridge break?
	    b. Can you improve the strength in this area?
	    c. Can you remove material from the places on the bridge that are intact to lower the price?
	    d. Where in the coordinate system do you want your bridge to be placed?
	    e. What can you do to achieve this?
	7. Now have the students redesign their bridge, and repeat the process as many times as possible within the time constraints of the day.
	8. When you can compare all the bridges of the different groups, the groups can each pitch their bridge design to the teachers and the other students, explaining the benefits of their design.

10. Feedback	The use of the Oresmian coordinate system will make the performance of each bridge apparent to the students, and the reflective questions asked by the teacher can help guide the students in improving their design through reflections and iterations.
11. Assessment & Evaluation	The Oresmian coordinate system helps the students to self assess on the individual designs, but also on their process as a whole. If the performance of the design is not improving through the iterations, it will be very clear, and the students will likely change their strategy.